

Concrete is produced by mixing cement, water, sand and stones (or rocks) into a paste. Portland cement is the basis of concrete – the substance that, together with water, holds sand and stones together. This occurs when the cement dries and hardens.

Cement hardens because of a chemical reaction. Cement is able to harden due to the water that is added in its mixture. The water causes aggregate bonds to form between it and the cement which eventually harden to its more functional form. The amount of water added is also a key factor to how strong the concrete will be.

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Cement used in construction can be characterised as being either hydraulic or non-hydraulic. Non-hydraulic cement such as slaked lime (calcium hydroxide mixed with water) hardens due to the reaction with carbon dioxide naturally present in the air.

Hydraulic cement (e.g. Portland cement) hardens because of the addition of water. A chemical reaction occurs between the dried cement powder and water. The chemistry ruling the action of the hydraulic cement is the addition of water. Hydraulic cement (such as the Portland cement) is made of a mixture of silicates and oxides, with four main components. One component being: tricalcium silicate ( $\text{Ca}_3\text{SiO}_5$ ).

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When hydraulic cement sets a chemical reaction occurs between tricalcium silicate and water. When water is added, tricalcium silicate reacts. Calcium ions, hydroxide ions and heat are released. The pH increases due to the release of hydroxide ions.

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This reaction continues slowly until the system becomes saturated and calcium hydroxide starts to crystallise. Calcium silicate hydrate also crystallise and grow bigger. This makes it difficult for water molecules to reach the dry tricalcium silicate and the rate at this occurring controls the speed of the reaction.